

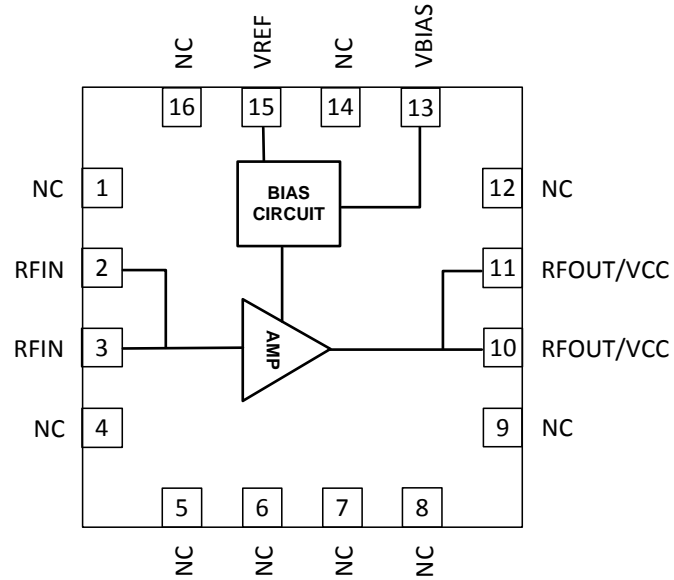


Features

- -60dBc ACPR at 15.5dBm WCDMA
- 0.5W Output Power (P1dB)
- NF = 3.8dB at 2140MHz
- Gain = 15.7dB at 2140MHz
- Power-down Capability

Applications

- GaAs Pre-Driver for Base Station Amplifiers
- PA Stage for Commercial Wireless Infrastructure
- 2nd or 3rd Stage LNAs
- Class AB Operation for GSM, DCS, PCS, UMTS, WiMAX, TD-SCDMA, LTE Transceiver Applications



Functional Block Diagram

Product Description

The RFPA2013 is a single-stage GaAs HBT power amplifier specifically designed for Wireless Infrastructure applications. It offers ultra-linear operation at a comparably low DC power, making it ideal for next generation radios requiring high efficiency. Its external matching allows for use across various radio platforms within 400MHz to 2700MHz. The RFPA2013 offers a low noise figure, making it an excellent solution for 2nd and 3rd stage LNAs.

Ordering Information

| | |
|------------------|--|
| RFPA2013SR | 7" Sample reel with 100 pieces |
| RFPA2013SQ | Sample bag with 25 pieces |
| RFPA2013TR7 | 7" Reel with 750 pieces |
| RFPA2013TR13 | 13" Reel with 2500 pieces |
| RFPA2013PCK-410 | 2110MHz to 2170MHz PCBA with 5-piece sample bag |
| RFPA2013PCK-411 | 2600MHz to 2700MHz PCBA with 5-piece sample bag |
| RFPA2013PCK-412 | 2550MHz to 2650MHz PCBA with 5-piece sample bag |
| 869MHz to 894MHz | PCBA Not Available Online, Contact Product Line Apps |

Optimum Technology Matching® Applied

- | | | | |
|--|--------------------------------------|-------------------------------------|-----------------------------------|
| <input checked="" type="checkbox"/> GaAs HBT | <input type="checkbox"/> SiGe BiCMOS | <input type="checkbox"/> GaAs pHEMT | <input type="checkbox"/> GaN HEMT |
| <input type="checkbox"/> GaAs MESFET | <input type="checkbox"/> Si BiCMOS | <input type="checkbox"/> Si CMOS | <input type="checkbox"/> RF MEMS |
| <input type="checkbox"/> InGaP HBT | <input type="checkbox"/> SiGe HBT | <input type="checkbox"/> Si BJT | <input type="checkbox"/> LDMOS |

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Absolute Maximum Ratings

| Parameter | Rating | Unit |
|--|-------------|------|
| Supply Voltage (V_{CC} , V_{BIAS}) | 6.0 | V |
| DC Supply Current (I_{CC}) | 380 | mA |
| CW Input Power, 2:1 Output VSWR | 20 | dBm |
| Output Load VSWR at P3dB | 5:1 | |
| Operating Junction Temperature | 160 | °C |
| Operating Temperature Range (T_L) | -40 to +85 | °C |
| Storage Temperature | -40 to +150 | °C |
| ESD Rating – Human Body Model (HBM) | Class 1C | |
| Moisture Sensitivity Level | MSL-1 | |

Notes:

- The maximum ratings must all be met simultaneously.
- $P_{DISS} = P_{DC} + P_{RFIN} - P_{RFOUT}$
- $T_J = T_L + P_{DISS} * R_{TH}$



Caution! ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

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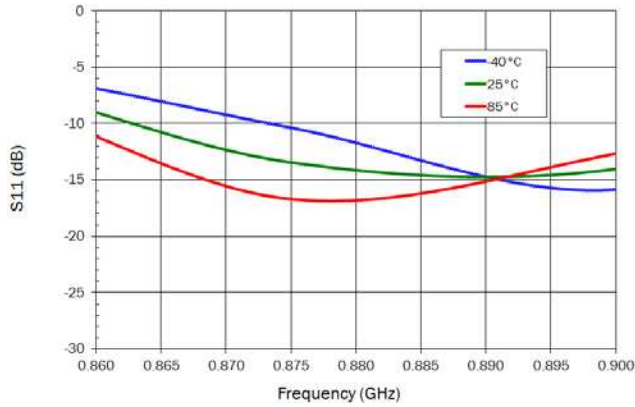
RFMD Green: RoHS compliant per EU Directive 2002/95/EC, halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

| Parameter | Specification | | | Unit | Condition |
|--|---------------|------|------|------|---|
| | Min. | Typ. | Max. | | |
| 869MHz to 894MHz | | | | | |
| $V_{CC} = 5.0V$, $I_{CC} = 165mA$, linear tune | | | | | |
| Frequency | | 880 | | MHz | EVB tuned for WCDMA 60dBc linear operation |
| Input Power (P_{IN}) | | | 10 | dBm | Max recommended continuous input power, $V_{CC} < 6.0V$, load VSWR < 2:1 |
| Gain (S21) | | 21.8 | | dB | |
| OIP3 | | 41 | | dBm | 15dBm/tone, tone spacing = 1MHz |
| P1dB | | 27.5 | | dBm | EVB tuned for linear operation |
| Input Return Loss (S11) | | 14 | | dB | |
| Output Return Loss (S22) | | 8 | | dB | |
| Noise Figure | | 3.8 | | dB | |
| WCDMA Channel Power at -55dBc ACPR | | 16.5 | | dBm | 3GPP 3.5, test model 1, 64 DPCH |
| 2110MHz to 2170MHz | | | | | |
| $V_{CC} = 5.0V$, $I_{CC} = 165mA$, linear tune | | | | | |
| Frequency | | 2140 | | MHz | EVB tuned for WCDMA 60dBc linear operation |
| Input Power (P_{IN}) | | | 16 | dBm | Max recommended continuous input power, $V_{CC} < 6.0V$, load VSWR < 2:1 |
| Gain (S21) | | 15.7 | | dB | |
| OIP3 | | 41.5 | | dBm | 15dBm/tone, tone spacing = 1MHz |
| P1dB | | 27 | | dBm | EVB tuned for linear operation |
| Input Return Loss (S11) | | 14 | | dB | |
| Output Return Loss (S22) | | 10.5 | | dB | |
| Noise Figure | | 3.8 | | dB | |
| WCDMA Channel Power at -55dBc ACPR | | 16.5 | | dBm | 3GPP 3.5, test model 1, 64 DPCH |

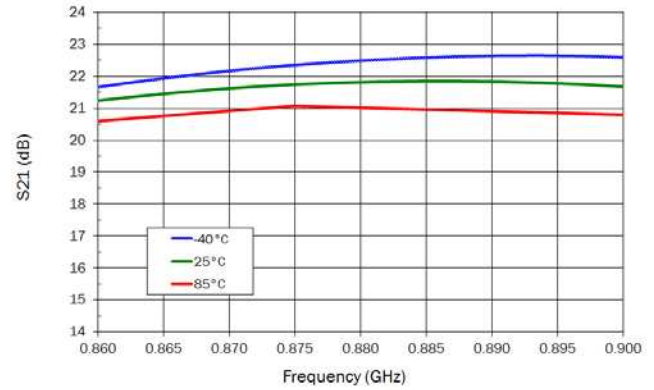
| Parameter | Specification | | | Unit | Condition |
|--|---------------|------|------|---------|---|
| | Min. | Typ. | Max. | | |
| 2550MHz to 2650MHz | | | | | $V_{CC} = 5.0V, I_{CQ} = 165mA$, linear tune |
| Frequency | | 2600 | | MHz | EVB tuned for WCDMA 60dBc linear operation |
| Input Power (P_{IN}) | | | 17 | dBm | Max recommended continuous input power, $V_{CC} < 6.0V$, load VSWR < 2:1 |
| Gain (S21) | | 14.1 | | dB | |
| OIP3 | | 41 | | dBm | 15dBm/tone, tone spacing = 1MHz |
| P1dB | | 26.8 | | dBm | EVB tuned for linear operation |
| Input Return Loss (S11) | | 12.5 | | dB | |
| Output Return Loss (S22) | | 12 | | dB | |
| Noise Figure | | 3.4 | | dB | |
| WCDMA Channel Power at -55dBc ACPR | | 16.0 | | dBm | 3GPP 3.5, test model 1, 64 DPCH |
| 2600MHz to 2700MHz | | | | | $V_{CC} = 5.0V, I_{CQ} = 165mA$, linear tune |
| Frequency | | 2650 | | MHz | EVB tuned for WCDMA 60dBc linear operation |
| Input Power (P_{IN}) | | | 17 | dBm | Max recommended continuous input power, $V_{CC} < 6.0V$, load VSWR < 2:1 |
| Gain (S21) | | 14.4 | | dB | |
| OIP3 | | 40 | | dBm | 15dBm/tone, tone spacing = 1MHz |
| P1dB | | 27 | | dBm | EVB tuned for linear operation |
| Input Return Loss (S11) | | 13.5 | | dB | |
| Output Return Loss (S22) | | 13.5 | | dB | |
| Noise Figure | | 3.4 | | dB | |
| WCDMA Channel Power at -55dBc ACPR | | 16.0 | | dBm | 3GPP 3.5, test model 1, 64 DPCH |
| Power Supply | | | | | |
| Operating Current (Quiescent) | | 165 | | mA | At $V_{BIAS} = V_{CC} = 5.0V$ |
| Operating Voltage (V_{CC}) | | 5.0 | 6.0 | V | Max recommended collector voltage |
| Operating Voltage (V_{BIAS}) | | 5.0 | 6.0 | V | $V_{BIAS} = V_{CC}$, under normal operating conditions |
| Power Down Current | | 10 | | μA | $V_{REF} = 0V, V_{BIAS} = V_{CC} = 5.0V$ |
| Thermal Resistance (R_{TH}) (Junction to EPAD) | | 60 | | C/W | Quiescent conditions |

Typical Performance: 869MHz to 894MHz Application Circuit

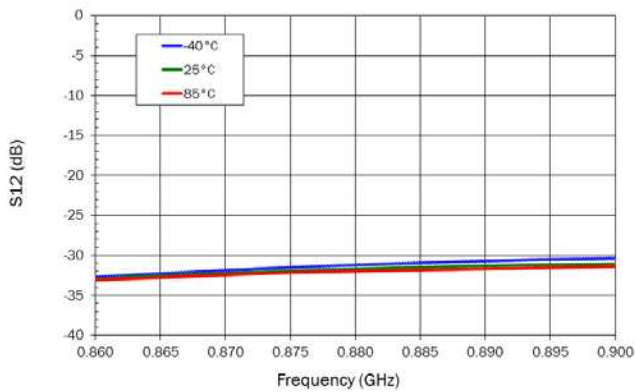
S11 versus Frequency



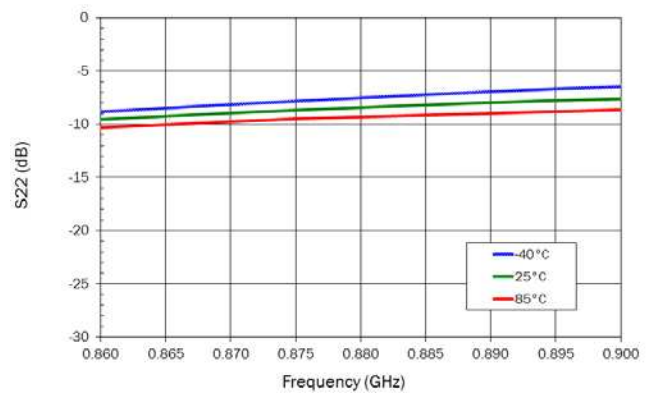
S21 versus Frequency



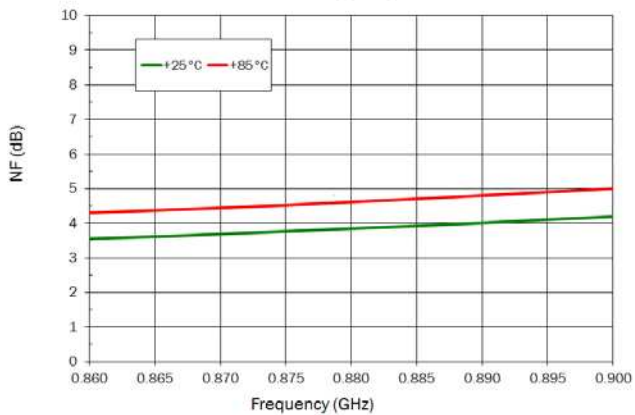
S12 versus Frequency



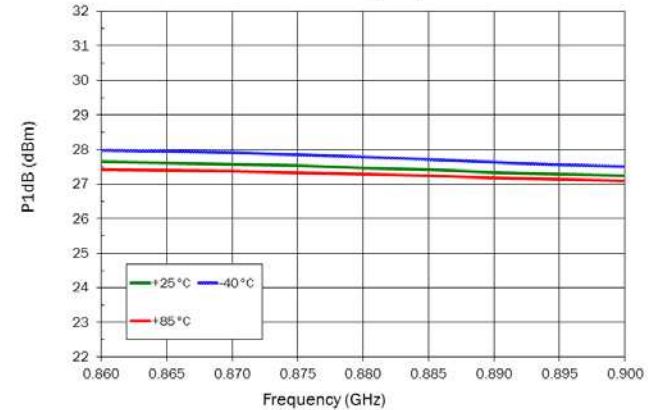
S22 versus Frequency



NF versus Frequency

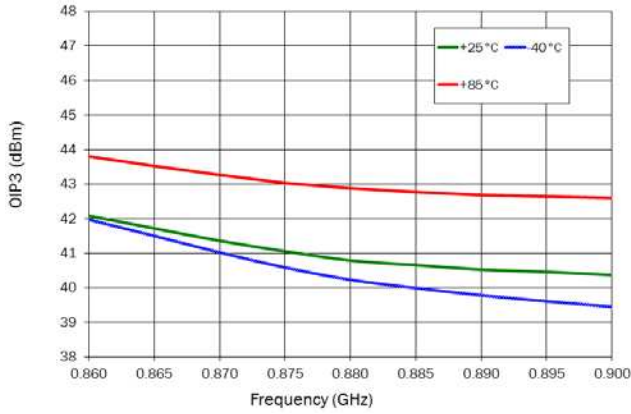


P1dB versus Frequency

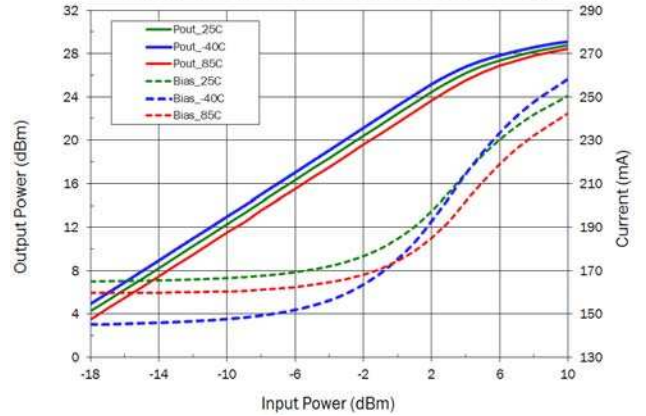


Typical Performance: 869MHz to 894MHz Application Circuit

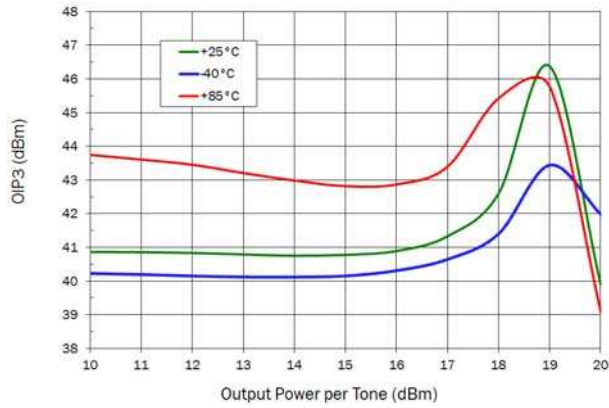
OIP3 versus Frequency(15dBm tones)



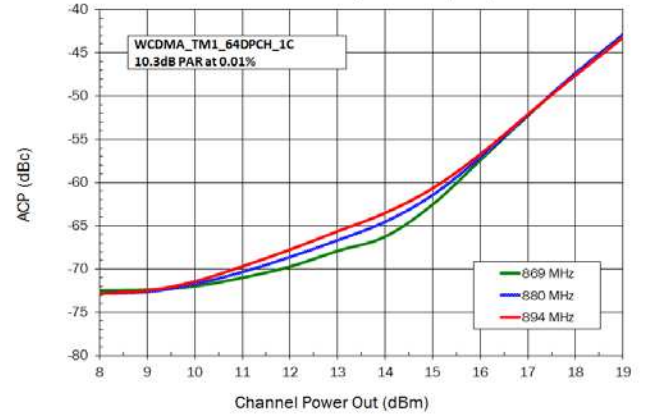
Output Power and Icc versus Input Power at 880MHz



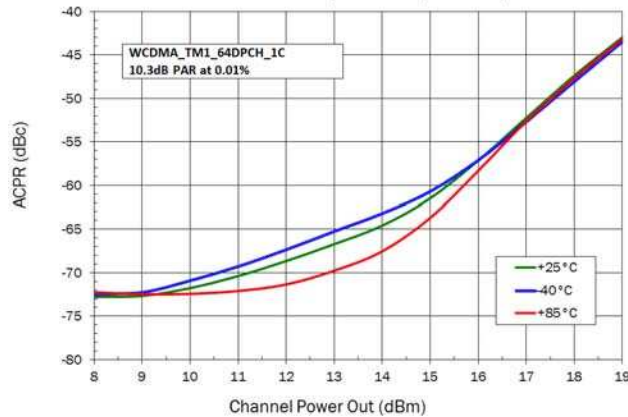
OIP3 versus Output Power (880MHz)



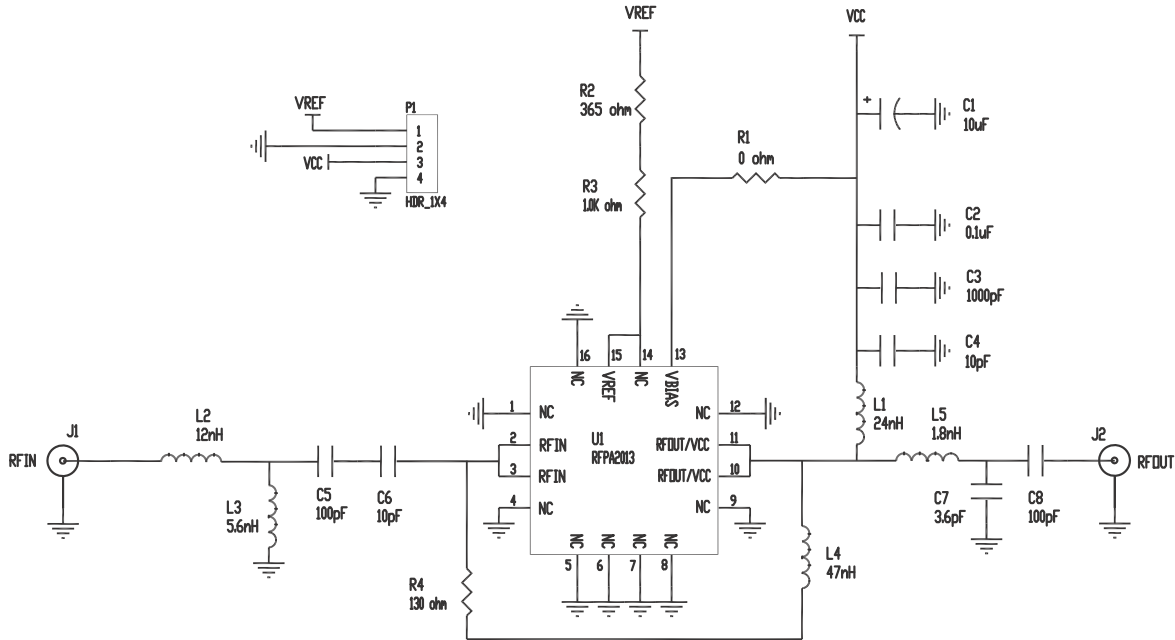
ACPR versus WCDMA Output Power (25C)



ACPR versus WCDMA Output Power (880MHz)



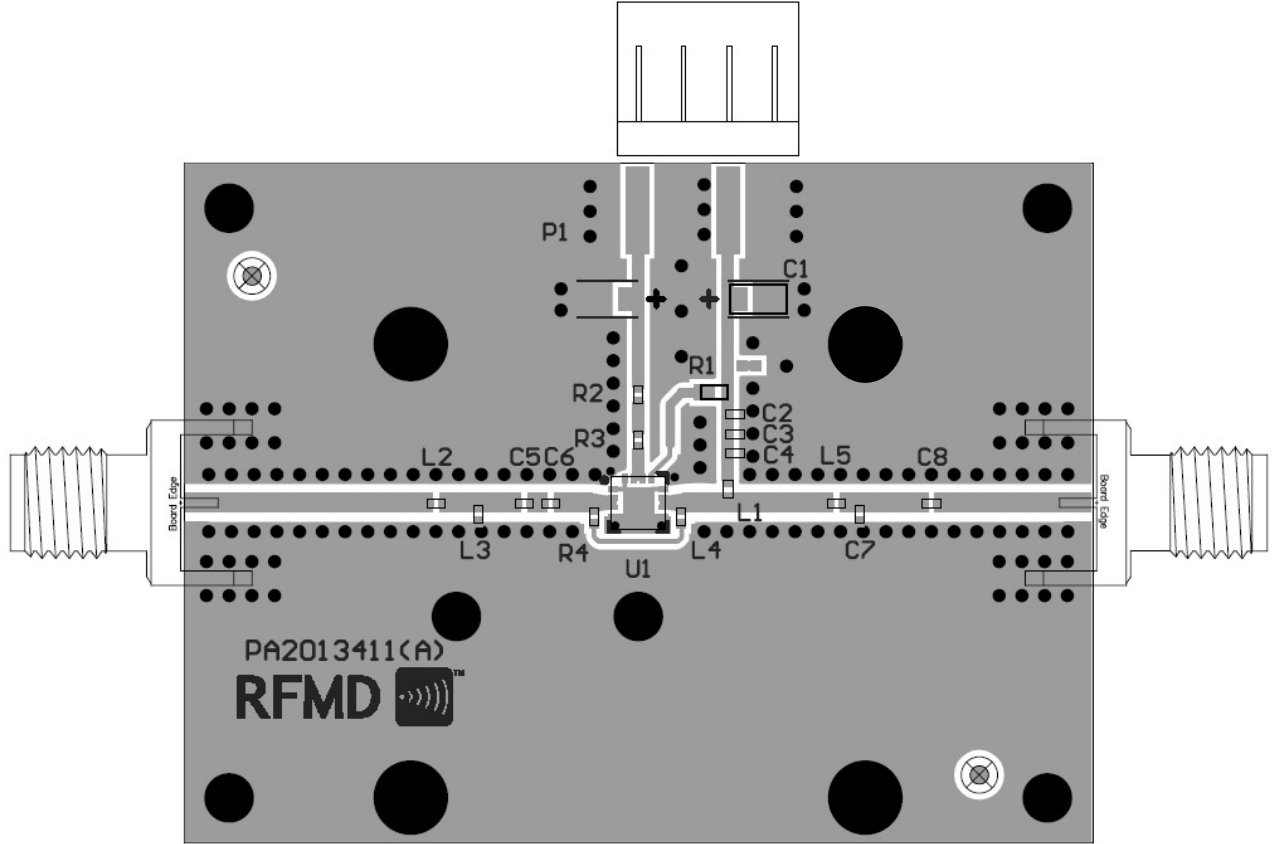
Evaluation Board Schematic 869MHz to 894MHz Application Circuit



Evaluation Board Bill of Materials (BOM) 869MHz to 894MHz Application Circuit

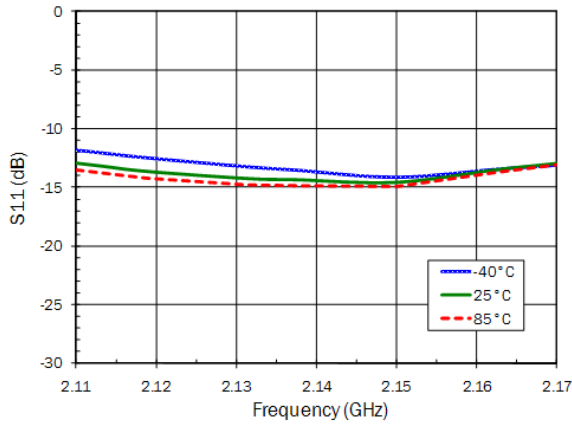
| Description | Reference Designator | Manufacturer | Manufacturer's P/N |
|--|----------------------|-------------------------|--------------------|
| Evaluation Board | | | PA2013411(A) |
| GaAs HBT Power Amplifier | U1 | RFMD | RFPA2013 |
| CAP, 10μF, 20%, 10V, TANT-A | C1 | Kemet | T491A106M010AT |
| CAP, 0.1μF, 10%, 16V, X7R, 0402 | C2 | Murata Electronics | GRM155R71C104KA88D |
| CAP, 1000pF, 10%, 50V, X7R, 0402 | C3 | Murata Electronics | GRM155R71H102KA01D |
| CAP, 10pF, 5%, 50V, COG, 0402 | C4, C6 | Murata Electronics | GRM1555C1H100JZ01E |
| CAP, 100pF, 5%, 50V, COG, 0402 | C5, C8 | Murata Electronics | GRM1555C1H101JA01D |
| CAP, 3.6pF, ±0.25pF, 50V, COG, 0402 | C7 | Murata Electronics | GRM1555C1H3R6CZ01E |
| CONN, SMA, END LNCH, MINI, FLT, 0.068" | J1, J2 | Emerson Networks | 142-0741-851 |
| IND, 24nH, 5%, W/W, 0603 | L1 | Coilcraft, Inc. | 0603HC-24NXJLW |
| IND, 12nH, 10%, M/L, 0402 | L2 | TOKO Inc. | LL1005-FHL12NJ |
| IND, 5.6nH, ±0.3nH, M/L, 0402 | L3 | TOKO Inc. | LL1005-FH5N6S |
| IND, 47nH, 5%, M/L, 0402 | L4 | TOKO Inc. | LL1005-FH47NJ |
| IND, 1.8nH, ±0.3nH, M/L, 0402 | L5 | TOKO Inc. | LL1005-FH1N8S |
| CONN, HDR, ST, PLRZD, 4-PIN, 0.100" | P1 | ITW Pancon | MPSS100-4-C |
| RES, 0Ω, 0402 | R1 | KAMAYA, INC | RMC1/16SJPTH |
| RES, 365Ω, 1%, 1/16W, 0402 | R2 | PANASONIC INDUSTRIAL CO | ERJ-2RKF3650 |
| RES, 1.0K, 1%, 1/16W, 0402 | R3 | PANASONIC INDUSTRIAL CO | ERJ-2RKF1001 |
| RES, 130Ω, 5%, 1/16W, 0402 | R4 | PANASONIC INDUSTRIAL CO | ERJ-2GEJ131 |

Evaluation Board Assembly Drawing
869MHz to 894MHz Application Circuit

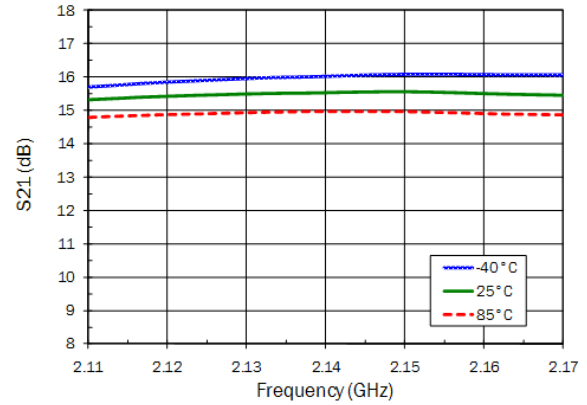


Typical Performance: 2110MHz to 2170MHz Application Circuit

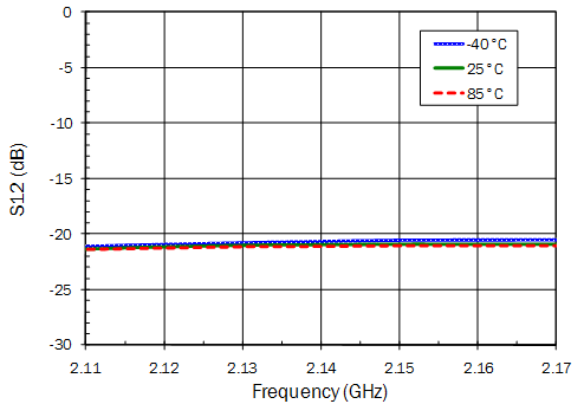
S11 versus Frequency



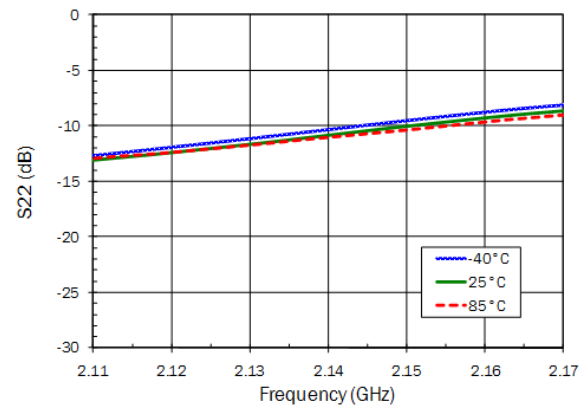
S21 versus Frequency



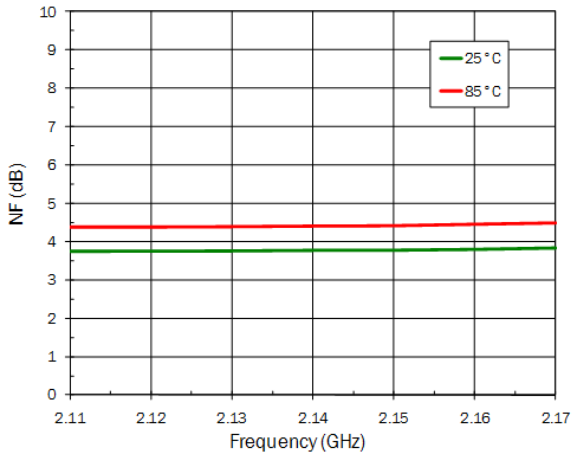
S12 versus Frequency



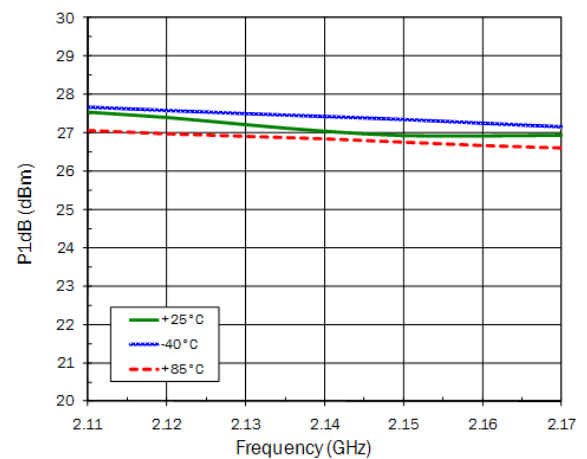
S22 versus Frequency



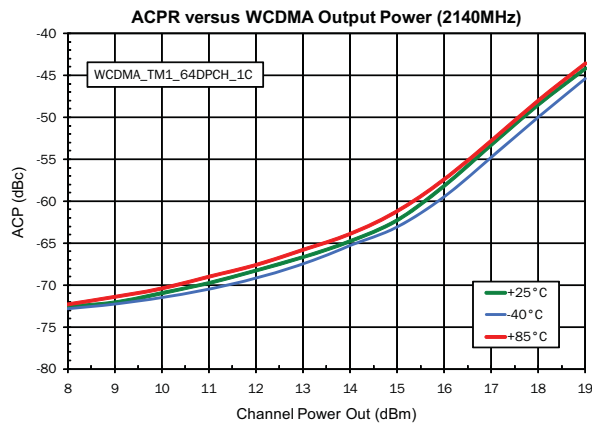
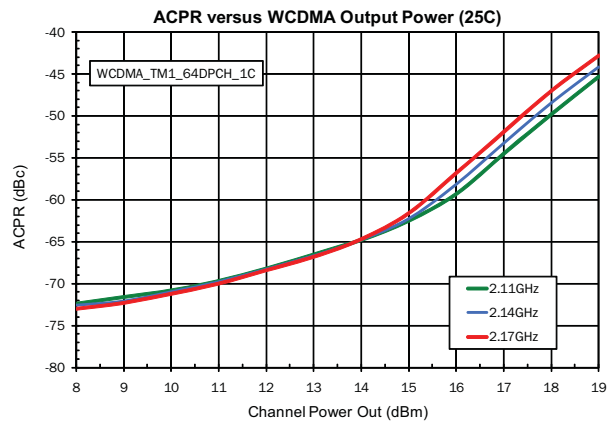
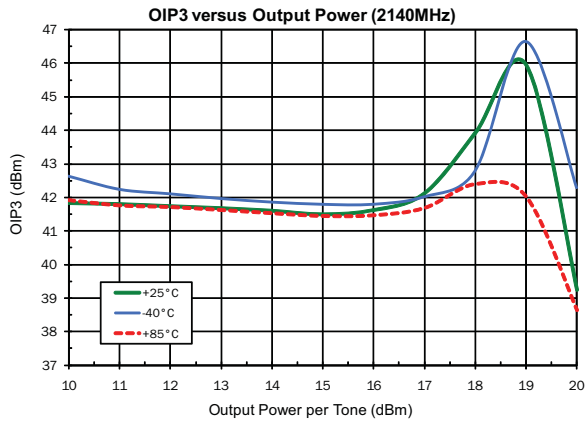
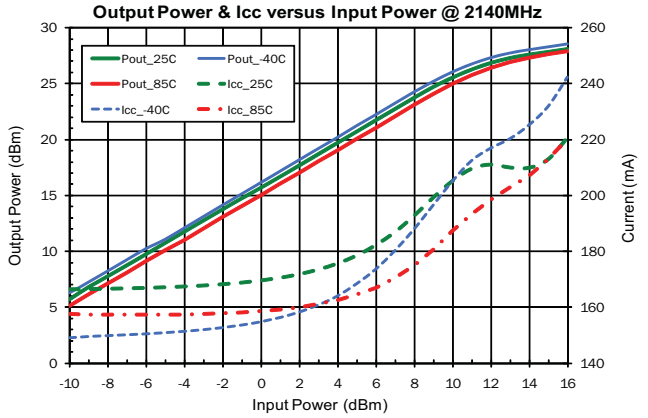
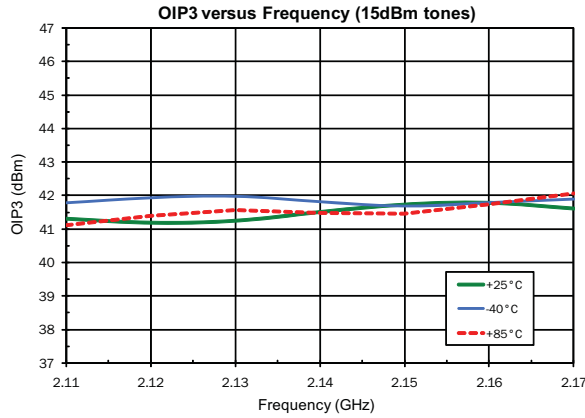
Noise Figure versus Frequency



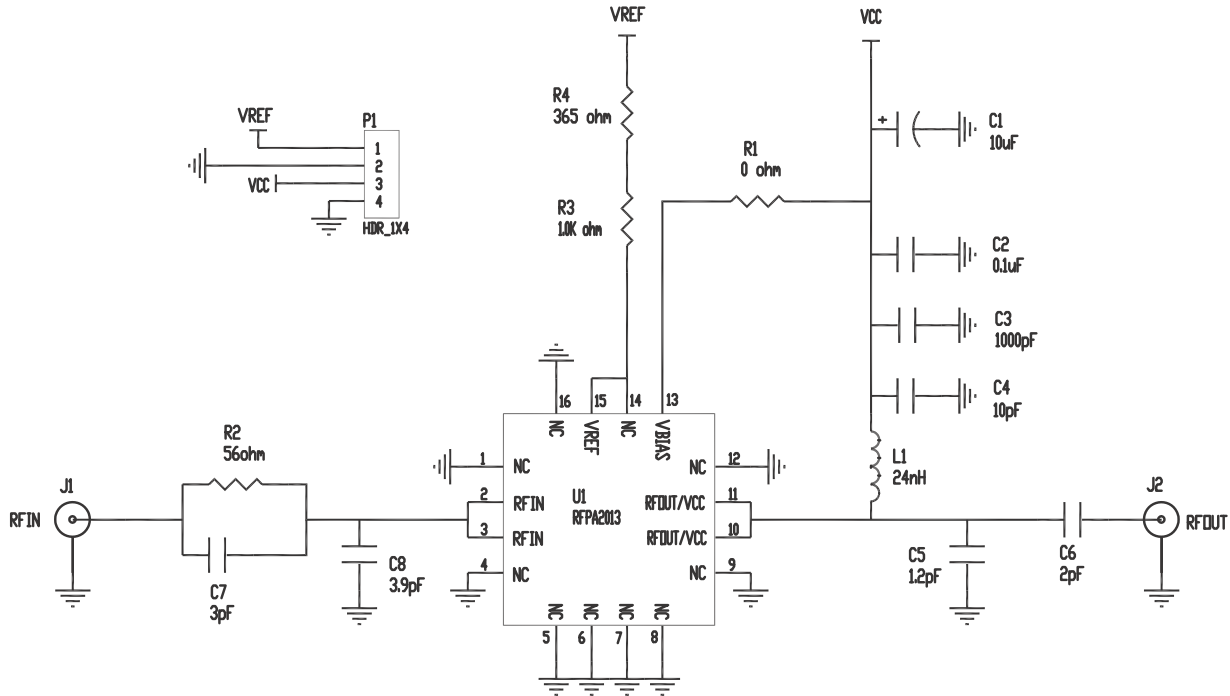
P1dB versus Frequency



Typical Performance: 2110MHz to 2170MHz Application Circuit



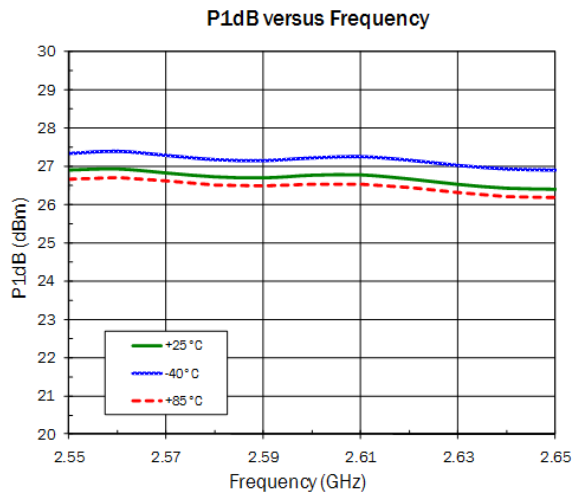
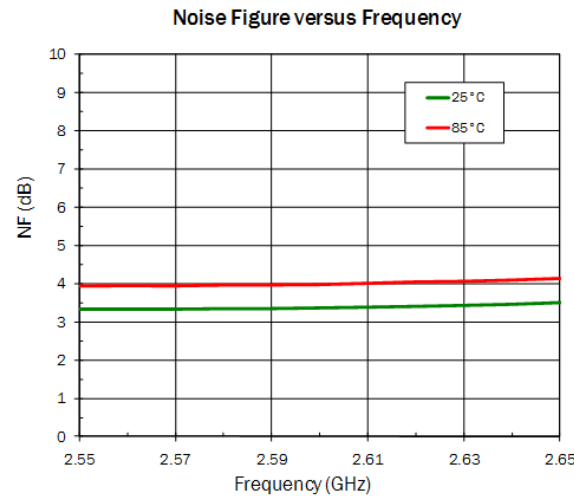
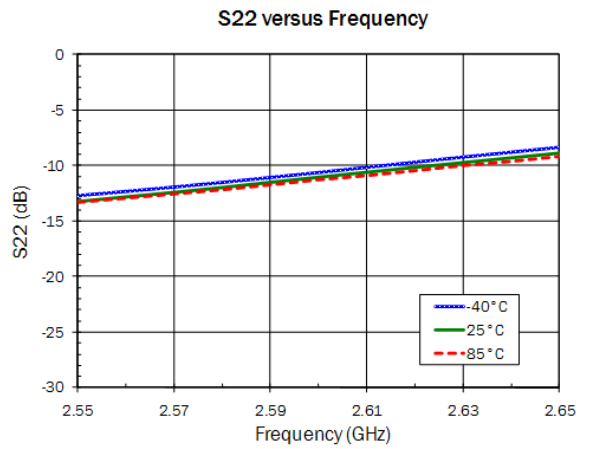
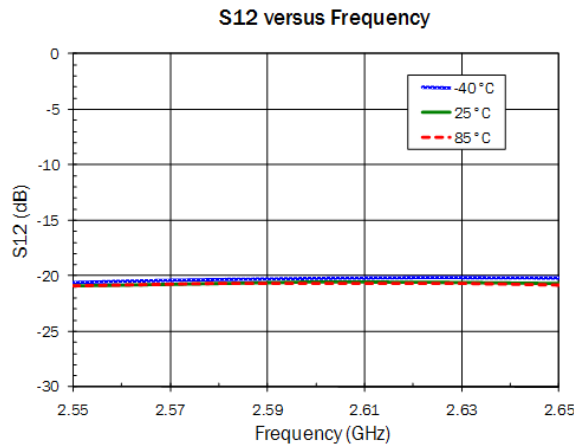
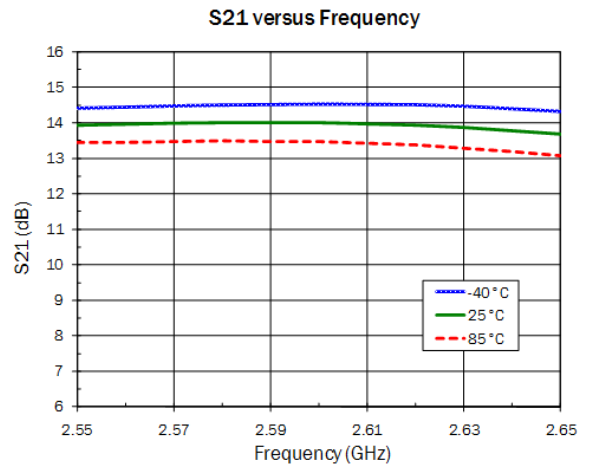
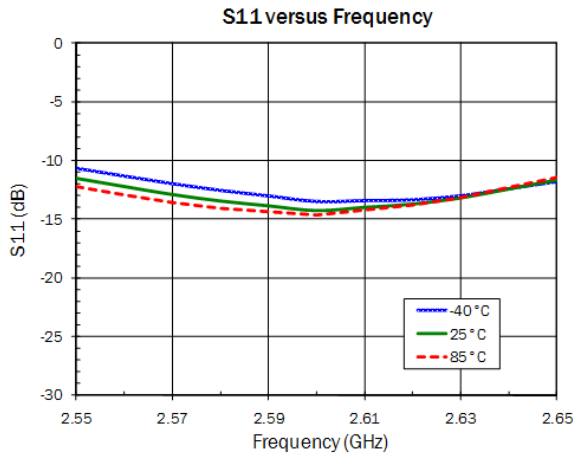
Evaluation Board Schematic 2110MHz to 2170MHz Application Circuit



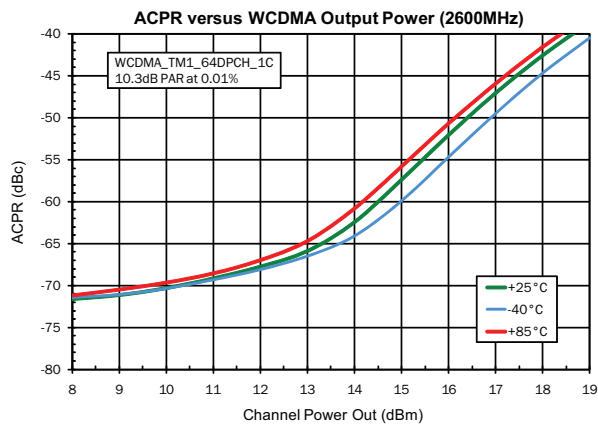
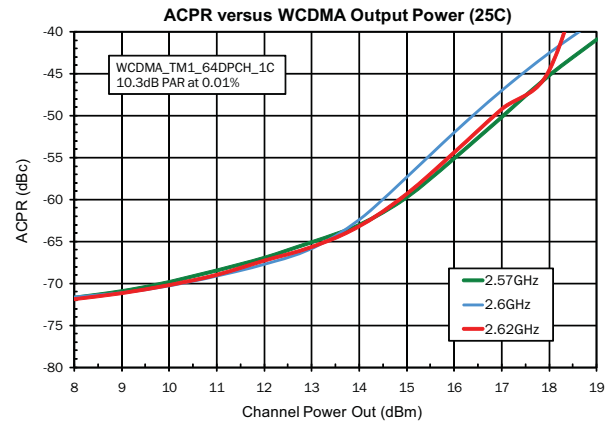
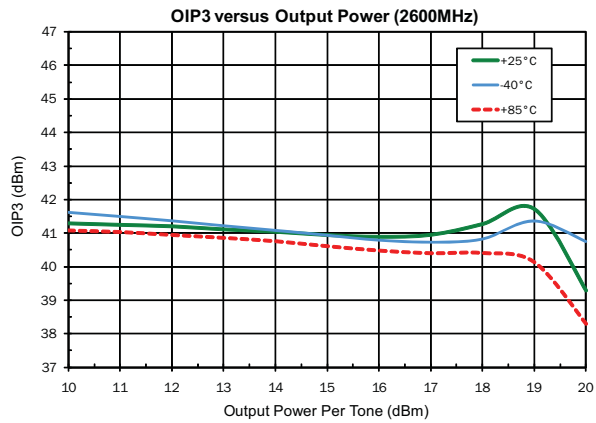
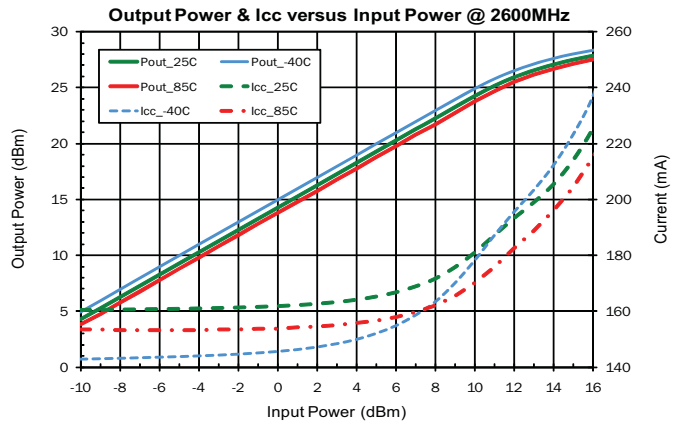
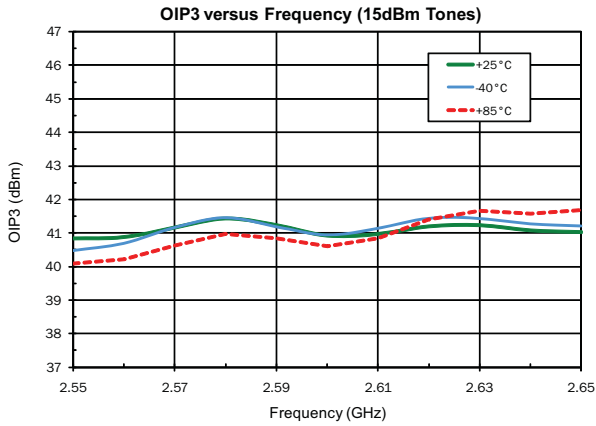
Evaluation Board Bill of Materials (BOM) 2110MHz to 2170MHz Application Circuit

| Description | Reference Designator | Manufacturer | Manufacturer's P/N |
|--|----------------------|-------------------------|--------------------|
| Evaluation Board | | | PA2013410(B) |
| GaAs HBT Power Amplifier | U1 | RFMD | RFPA2013 |
| CAP, 10μF, 20%, 10V, TANT-A | C1 | Kemet | T491A106M010AT |
| CAP, 0.1μF, 10%, 16V, X7R, 0402 | C2 | Murata Electronics | GRM155R71C104KA88D |
| CAP, 1000pF, 10%, 50V, X7R, 0402 | C3 | Murata Electronics | GRM155R71H102KA01D |
| CAP, 10pF, 5%, 50V, COG, 0402 | C4 | Murata Electronics | GRM1555C1H100JZ01E |
| CAP, 1.2pF, ±1pF, 50V, HI-Q, 0402 | C5 | Johanson Technology | 500R07S1R2BV4TD |
| CAP, 2pF, ±0.1pF, 50V, COG, 0402 | C6 | Murata Electronics | GRM1555C1H2R0BZ01E |
| CAP, 3pF, ±.1pF, 50V, COG, 0402 | C7 | Murata Electronics | GRM1555C1H3R0BZ01E |
| CAP, 3.9pF, ±0.25pF, 50V, COG, 0402 | C8 | Murata Electronics | GRM1555C1H3R9CZ01E |
| CONN, SMA, END LNCH, MINI, FLT, 0.068" | J1, J2 | Emerson Networks | 142-0741-851 |
| IND, 24nH, 5%, W/W, 0603 | L1 | Coilcraft, Inc. | 0603HC-24NXJLW |
| CONN, HDR, ST, PLRZD, 4-PIN, 0.100" | P1 | ITW Pancon | MPSS100-4-C |
| RES, 0Ω, 0402 | R1 | KAMAYA, INC | RMC1/16SJPTH |
| RES, 56Ω, 5%, 1/16W, 0402 | R2 | PANASONIC INDUSTRIAL CO | ERJ-2GEJ560 |
| RES, 1.0K, 1%, 1/16W, 0402 | R3 | PANASONIC INDUSTRIAL CO | ERJ-2RKF1001 |
| RES, 365Ω, 1%, 1/16W, 0402 | R4 | PANASONIC INDUSTRIAL CO | ERJ-2RKF3650 |
| DO NOT PLACE (DNP) | R5, R6, C9-C21 | | |

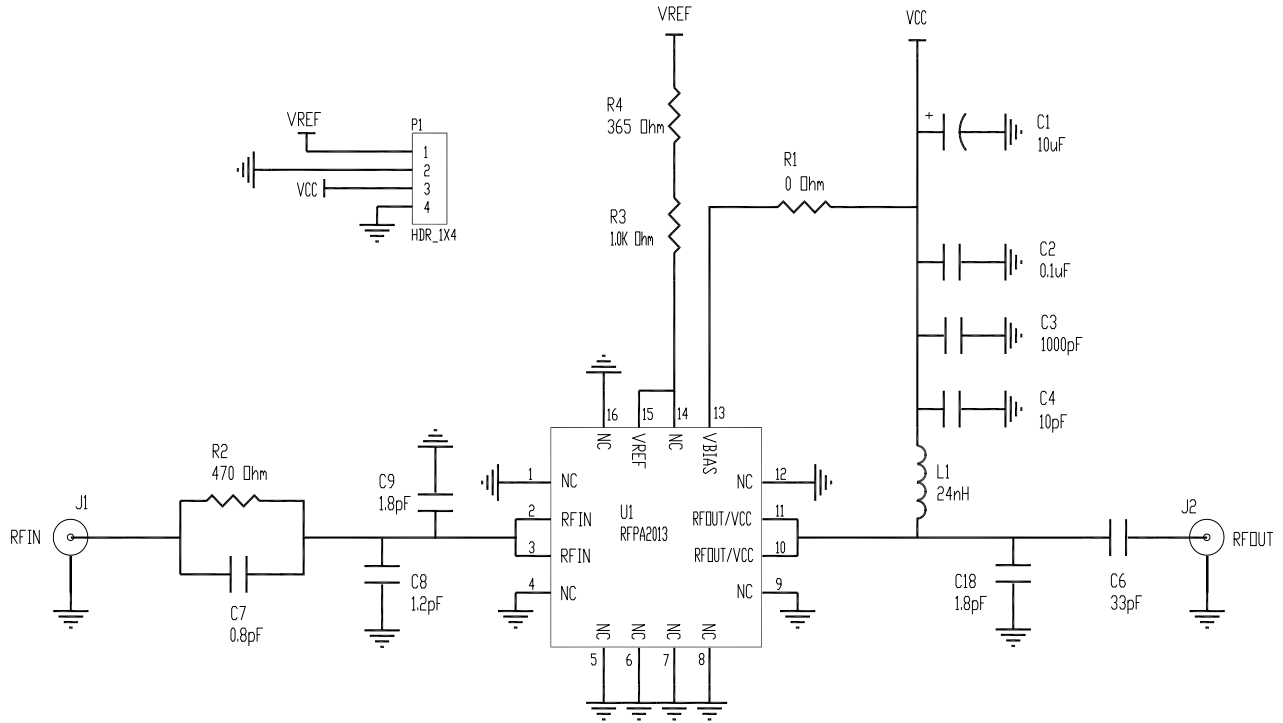
Typical Performance: 2550MHz to 2650MHz Application Circuit



Typical Performance: 2550MHz to 2650MHz Application Circuit



Evaluation Board Schematic
2550MHz to 2650MHz Application Circuit

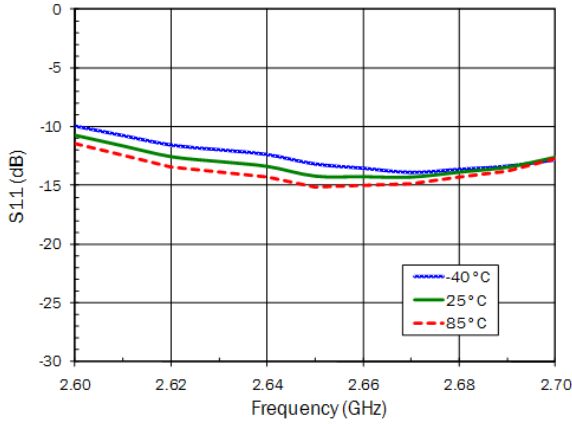


Evaluation Board Bill of Materials (BOM)
2550MHz to 2650MHz Application Circuit

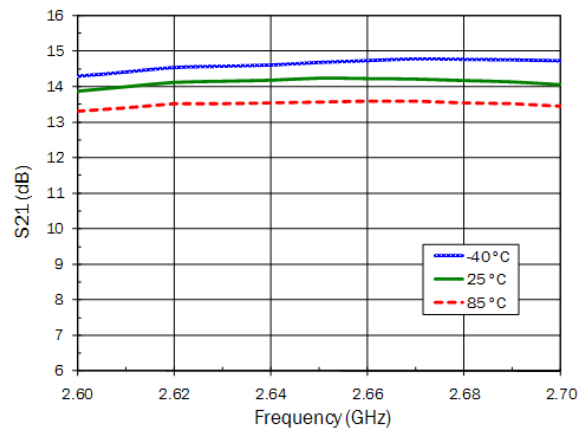
| Description | Reference Designator | Manufacturer | Manufacturer's P/N |
|--|-----------------------------|--------------------------|--------------------|
| Evaluation Board | | DDI | PA2013410(B) |
| GaAs HBT Power Amplifier | U1 | RFMD | RFPA2013 |
| CAP, 10μF, 20%, 10V, TANT-A | C1 | Kemet | T491A106M010AT |
| CAP, 0.1μF, 10%, 16V, X7R, 0402 | C2 | Murata Electronics | GRM155R71C104KA88D |
| CAP, 1000pF, 10%, 50V, X7R, 0402 | C3 | Murata Electronics | GRM155R71H102KA01D |
| CAP, 10pF, 5%, 50V, COG, 0402 | C4 | Murata Electronics | GRM1555C1H100JZ01E |
| CAP, 33pF, 5%, 50V, COG, 0402 | C6 | Murata Electronics | GRM1555C1H330JZ01E |
| CAP, 0.8pF, +/-0.1pF, 50V, HI-Q, 0402 | C7 | Johanson Technology | 500R07S0R8BV4TD |
| CAP, 1.2pF, +/-0.1pF, 50V, HI-Q, 0402 | C8 | Johanson Technology | 500R07S1R2BV4TD |
| CAP, 1.8pF, +/-0.1pF, 50V, HI-Q, 0402 | C9, C18 | Johanson Technology | 500R07S1R8BV4TD |
| CONN, SMA, END LNCH, MINI, FLT, 0.068" | J1-J2 | Emerson Networks | 142-0741-851 |
| IND, 24nH, 5%, W/W, 0603 | L1 | Coilcraft, Inc. | 0603HC-24NXJLW |
| CONN, HDR, ST, PLRZD, 4-PIN, 0.100" | P1 | ITW Pancon | MPSS100-4-C |
| RES, 0Ω, 0402 | R1 | Kamaya, Inc | RMC1/16SJPTH |
| RES, 470Ω, 5%, 1/16W, 0402 | R2 | Kamaya, Inc | RMC1/16S-471JTH |
| RES, 1K, 5%, 1/16W, 0402 | R3 | Kamaya, Inc | RMC1/16S-102JTH |
| RES, 365Ω, 1%, 1/16W, 0402 | R4 | Panasonic Industrial Co. | ERJ-2RKF3650X |
| DO NOT PLACE (DNP) | C5, C10-C17, C19-C23, R5-R6 | | |

Typical Performance: 2600MHz to 2700MHz Application Circuit

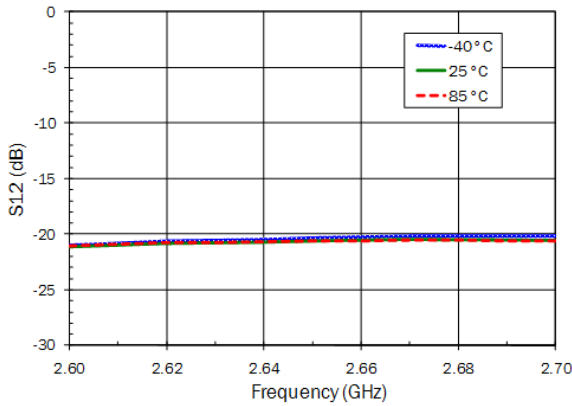
S11 versus Frequency



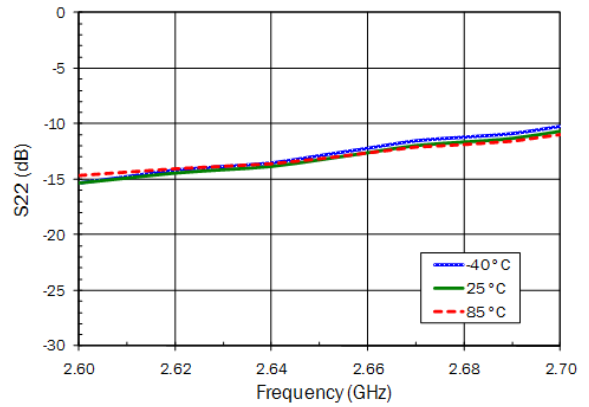
S21 versus Frequency



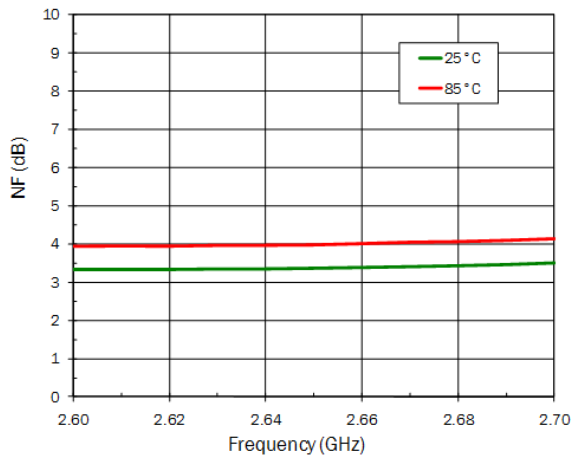
S12 versus Frequency



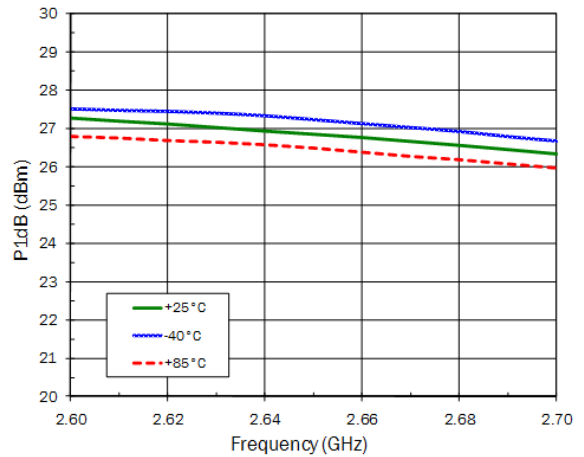
S22 versus Frequency



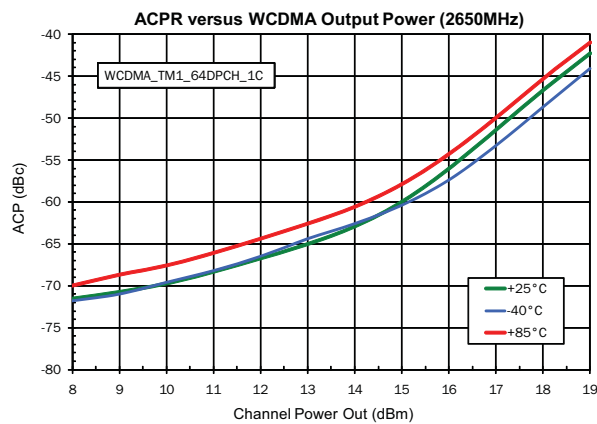
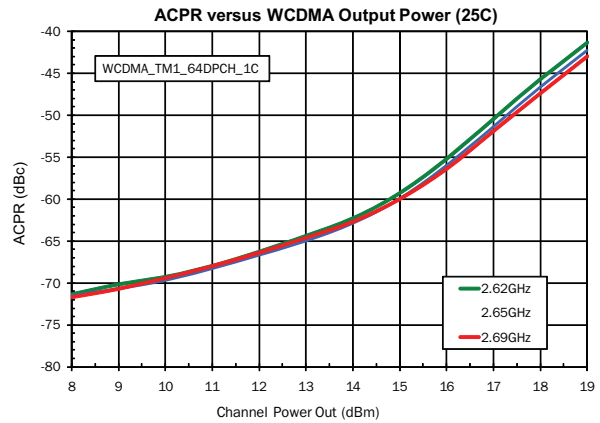
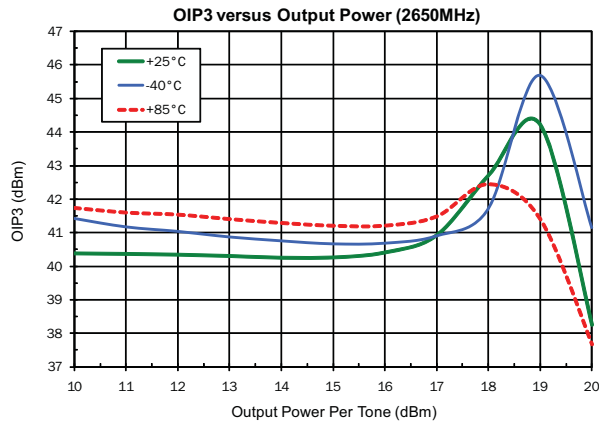
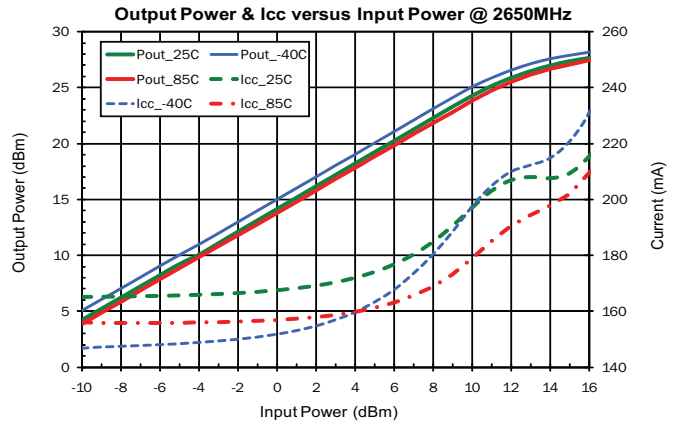
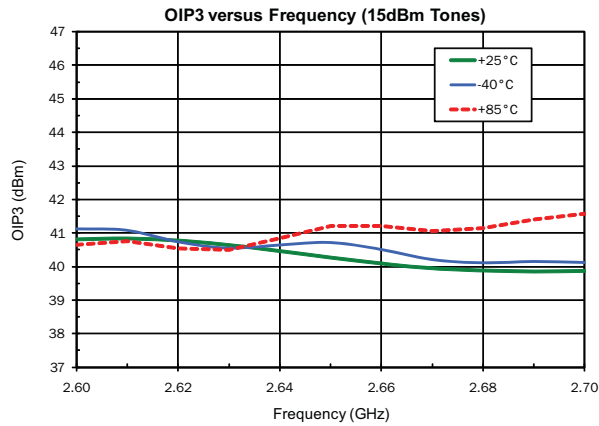
Noise Figure versus Frequency



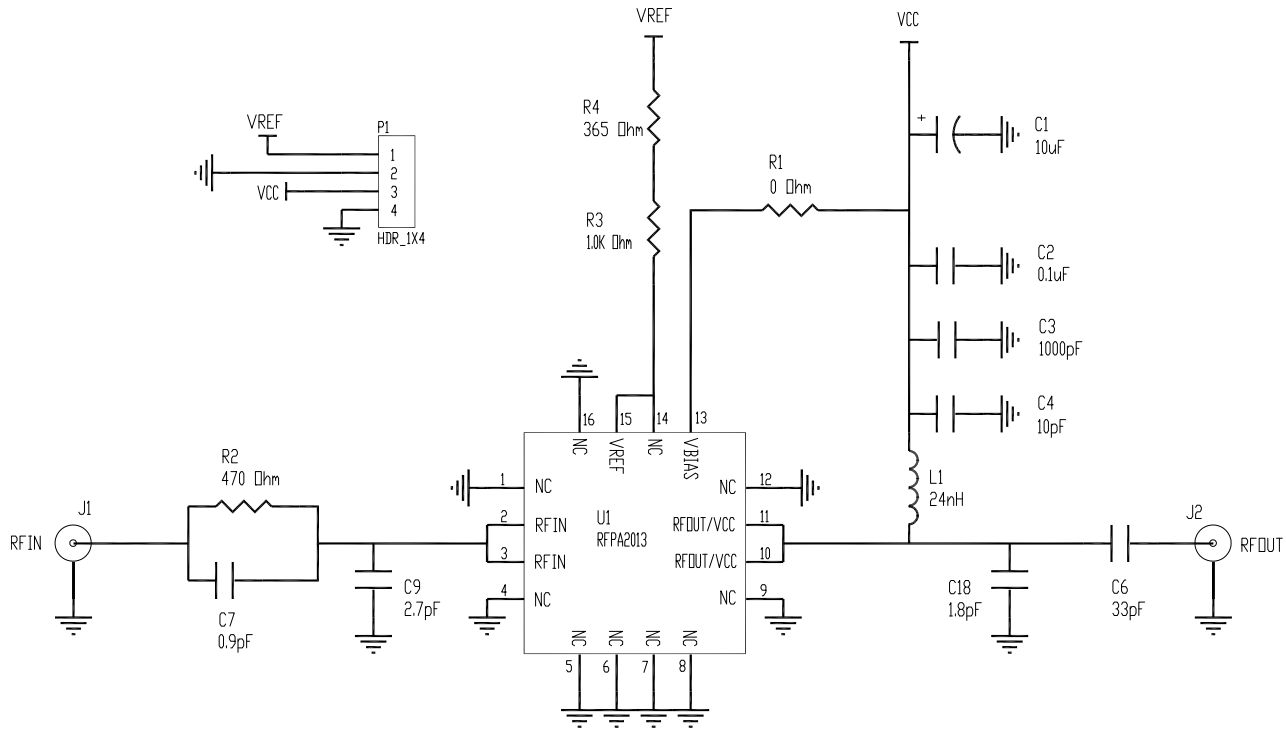
P1dB versus Frequency



Typical Performance: 2600MHz to 2700MHz Application Circuit



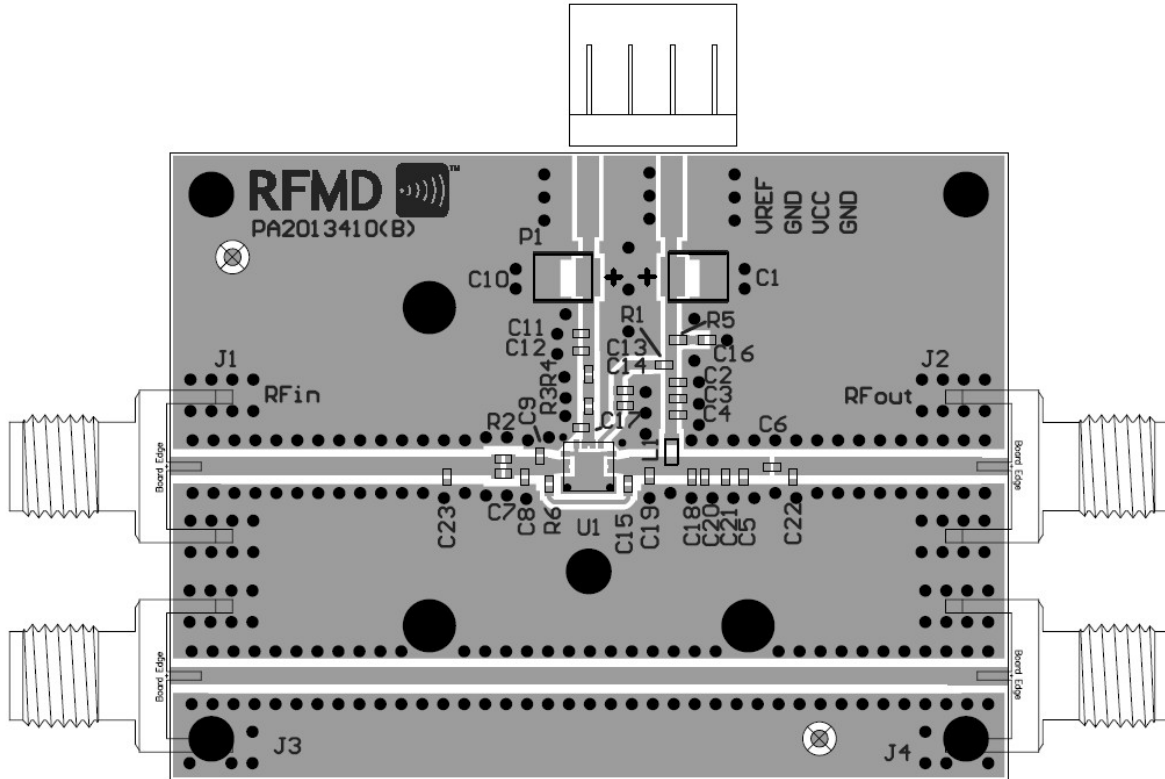
Evaluation Board Schematic 2600MHz to 2700MHz Application Circuit



Evaluation Board Bill of Materials (BOM) 2600MHz to 2700MHz Application Circuit

| Description | Reference Designator | Manufacturer | Manufacturer's P/N |
|--|---------------------------------|--------------------------|--------------------|
| Evaluation Board | | DDI | PA2013410(B) |
| GaAs HBT Power Amplifier | U1 | RFMD | RFPA2013 |
| CAP, 10μF, 20%, 10V, TANT-A | C1 | Kemet | T491A106M010AT |
| CAP, 0.1μF, 10%, 16V, X7R, 0402 | C2 | Murata Electronics | GRM155R71C104KA88D |
| CAP, 1000pF, 10%, 50V, X7R, 0402 | C3 | Murata Electronics | GRM155R71H102KA01D |
| CAP, 10pF, 5%, 50V, COG, 0402 | C4 | Murata Electronics | GRM1555C1H100JZ01E |
| CAP, 1.8pF, +/-0.1PF, 50V, HI-Q, 0402 | C18 | Johanson Technology | 500R07S1R8BV4TD |
| CAP, 33pF, 5%, 50V, COG, 0402 | C6 | Murata Electronics | GRM1555C1H330JZ01E |
| CAP, 0.9pF, +/-0.1pF, 50V, HI-Q, 0402 | C7 | Johanson Technology | 500R07S0R9BV4TD |
| CAP, 2.7pF, +/-0.1pF, 50V, HI-Q, 0402 | C9 | Johanson Technology | 500R07S2R7BV4TD |
| CONN, SMA, END LNCH, MINI, FLT, 0.068" | J1-J2 | Emerson Networks | 142-0741-851 |
| IND, 24nH, 5%, W/W, 0603 | L1 | Coilcraft, Inc. | 0603HC-24NXJLW |
| CONN, HDR, ST, PLRZD, 4-PIN, 0.100" | P1 | ITW Pancon | MPSS100-4-C |
| RES, 0Ω, 0402 | R1 | Kamaya, Inc | RMC1/16SJPTH |
| RES, 470Ω, 5%, 1/16W, 0402 | R2 | Kamaya, Inc | RMC1/16S-471JTH |
| RES, 1K, 5%, 1/16W, 0402 | R3 | Kamaya, Inc | RMC1/16S-102JTH |
| RES, 365Ω, 1%, 1/16W, 0402 | R4 | Panasonic Industrial Co. | ERJ-2RKF3650X |
| DO NOT PLACE (DNP) | C5, C8, C10-C17, C19-C23, R5-R6 | | |

Evaluation Board Assembly Drawing
 For 2140MHz, 2600MHz, 2650MHz Application Circuits

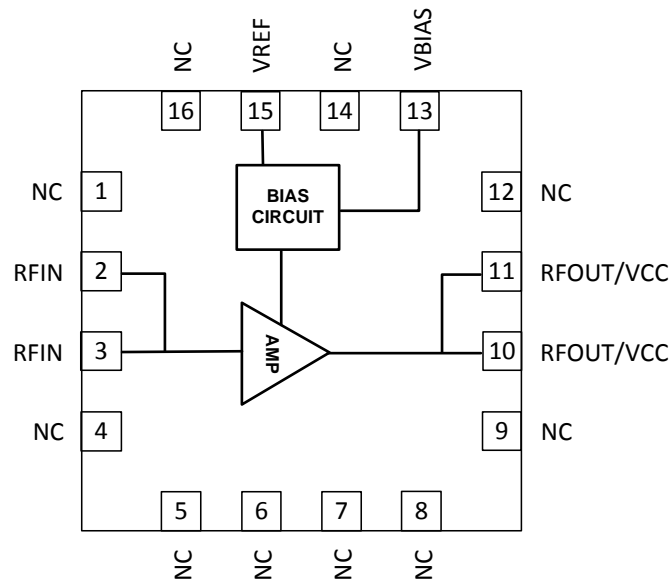


Note: See schematic and BOM for band-specific component requirements. Many components in the drawing above are Do-Not-Place.

Pin Names and Description

| Pin | Function | Description |
|------|-----------|--|
| 1 | NC | No internal connection. EVB can be ground or no connect. |
| 2 | RFIN | RF input. External DC block is required. |
| 3 | RFIN | RF input. External DC block is required. |
| 4 | NC | No internal connection. EVB can be ground or no connect. |
| 5 | NC | No internal connection. EVB can be ground or no connect. |
| 6 | NC | No internal connection. EVB can be ground or no connect. |
| 7 | NC | No internal connection. EVB can be ground or no connect. |
| 8 | NC | No internal connection. EVB can be ground or no connect. |
| 9 | NC | No internal connection. EVB can be ground or no connect. |
| 10 | RFOUT/VCC | RF output and collector bias |
| 11 | RFOUT/VCC | RF output and collector bias |
| 12 | NC | No internal connection. EVB can be ground or no connect. |
| 13 | VBIAS | Supply voltage for the active bias circuit |
| 14 | NC | No internal connection. EVB can be ground or no connect. |
| 15 | VREF | Bias control pin. Can also be used as a power-down pin. |
| 16 | NC | No internal connection. EVB can be ground or no connect. |
| EPAD | GND | DC and RF ground. Must be soldered to EVB ground plane over a bed of vias for thermal and RF performance. Solder/epoxy voids under the EPAD will result in excessive junction temperatures causing permanent damage. |

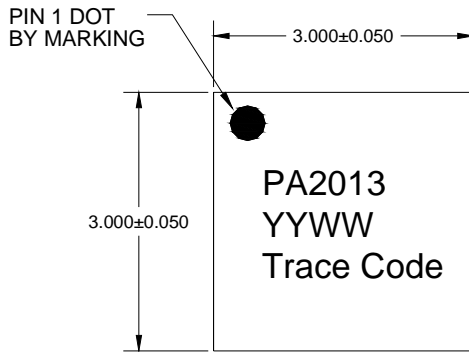
Pin Out



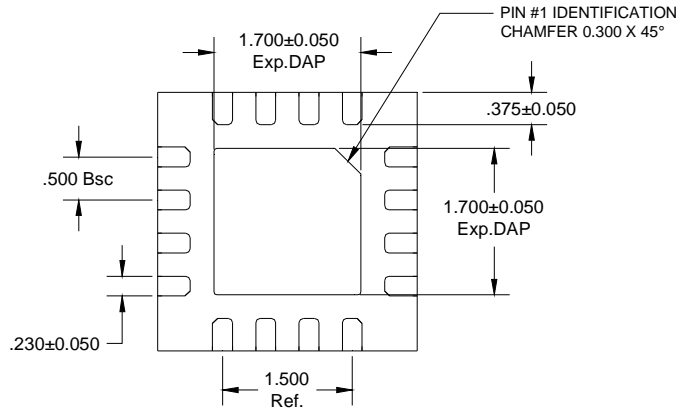
Package Drawing

Dimensions in millimeters [inches]

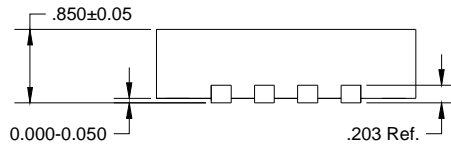
Refer to drawing posted at www.rfmd.com for tolerances.



TOP VIEW



BOTTOM VIEW



TOP VIEW

YYWW = date code, YY = year, WW = week
Trace Code assigned by SubCon